INVITED COMMENT

Regarding "The effect of venous anastomosis Tyrell vein patch collar on the primary patency of arteriovenous grafts in patients undergoing hemodialysis" and "Effects of a venous cuff at the venous anastomosis of polytetrafluoroethylene grafts for hemodialysis vascular access"

Julie A. Freischlag, MD, *Los Angeles, Calif*

Vascular access for dialysis continues to be a major health problem for patients with end-stage renal failure; it is the main reason they are admitted to the hospital and results in most of the morbidities they have. It is also a problem for vascular surgeons as they continue to watch their technically perfect anastomoses fail over a short period of time as a result of a process we still do not fully understand. Diminishing health care dollars are continuously spent on these access grafts to maintain graft patency for the preservation of life.

It is not disputable that autologous arteriovenous fistulas are the procedure of choice for any patient with end-stage renal failure because of the fistulas' superb patency and virtual zero infection rate. However, not all patients are candidates anatomically for these procedures, especially women, elderly patients, and patients with diabetes. Therefore, the search for a method to improve the patency of the prosthetic graft continues.

From the UCLA Gonda Goldschmied Vascular Center.
Competition of interest: 1235-6.
Reprint requests: Julie A. Freischlag, MD, UCLA Gonda Goldschmied Vascular Center, 200 UCLA Medical Plaza, Suite 510-5, Box 956908, Los Angeles, CA 90095-6908 (e-mail: jfreischlag@mednet.ucla.edu).
J Vasc Surg 2000;32:1235-6.

0741-5214/2000/$12.00 + 0 **24/9/109205**
doi:10.1067/mva.2000.109205

This excellent group of vascular access surgeons from the Norfolk Surgical Group and the Naval Medical Center at Portsmouth attempted the placement of a Tyrell vein collar in a prospective manner in patients who required a prosthetic dialysis access graft. Their expectations were that the proposed mechanism of the vein patch in arterial bypass grafts of decreased compliance mismatch and distortion would also decrease the proliferation on intimal hyperplasia at the venous anastomosis. The studies showed exactly the opposite, and the authors appropriately stopped their trial prematurely. Therefore, only 17 patients were randomized: 10 patients were in a control group, and seven patients received a Tyrell patch. The assumption that the different hemodynamic stresses seen in vascular access grafts are responsible is undoubtedly true; the mechanism is unclear. Continuous damage to the venous endothelium is also probably taking place with the creation of an arteriovenous graft and can contribute to a state of active vessel wall remodeling.

The second study published reports the results of a prospective, randomized multicenter trial in the Netherlands. Six hospitals participated. A total of 120 patients were enrolled in this study: 61 patients had no cuffs, and 59 patients had cuffs. Follow-up was quite complete with duplex scanning and angiograms being performed in all patients at 3 months. Even though the incidence of thrombotic occlusion was lower in those patients with a venous

cuff, primary and secondary patency rates were comparable between the two groups. The cuff group also had less stenosis as shown with duplex scan and angiogram. Poorer patency rates in their series were associated with small vein diameter (< 4 mm) and local problems such as obesity, local edema, and skin atrophy that led to wound problems.

These two studies provide clinical information that reveals that all intimal hyperplasia is not the same: intimal hyperplasia occurring solely in an arterial anastomosis is different than that occurring solely in a venous anastomosis. Certainly, as shown in these two studies, an arteriovenous anastomosis develops a different type of anastomotic intimal hyperplasia. The high turbulent flow results in alterations of sheer stress and vessel wall interactions with bloodborne elements such as red blood cells, white blood cells, and platelets. Active damage that requires remodeling of the vessel possibly contributes to the accelerated venous outflow lesion of intimal hyperplasia in this setting. It is a lesion that is affected each day because of the high-flow dynamics.[1,2]

The arterial injury that occurs when a prosthetic graft is placed involves the body's reaction to the foreign substance with the subsequent activation of macrophages. These macrophages can then release chemotactic factors such as platelet-derived growth factor, transforming growth factor–β, and, perhaps, angiotensin II.[3,4] These factors result in the migration of endothelial cells as well as smooth muscle cells. It is known then that these endothelial cells are dysfunctional and no longer produce their normal inhibitory products, such as nitric oxide, that help to maintain the proper physiology of the vessel wall. The smooth muscle cells proliferate, migrate, and become entrenched in the overproduction of extracellular matrix. All of these smooth muscle cell reactions lead to the production of the intimal hyperplastic lesion.

Shear stress has also been shown to augment the intimal hyperplastic response after placement of a prosthetic graft. Shear stress is directly related to the mean velocity through the graft and increases exponentially as the outflow narrows because of intimal hyperplasia.[5] The velocity that is created through an arteriovenous graft is much higher than that in an arterial bypass graft. Therefore, the fact that an increased amount of intimal hyperplasia is seen at the venous anastomosis is not surprising. Shear stress causes smooth muscle cells to proliferate and also causes the production of extracellular matrix.

The only effect that the addition of a vein patch could have had on the configuration of these prosthetic arteriovenous grafts was to add a larger diameter to accommodate the intimal hyperplasia longer before it became flow limiting. Veins exposed to arterial flow also lose their endothelial cell function. The increased wall tension and mechanical trauma also lead to smooth muscle cell proliferation, migration, and extracellular matrix production. The argument has been that in the arterial bypass graft circuit, these vein patches may increase compliance at the anastomosis, which could lead to decreased shear stress. However, in the dialysis graft, the high velocity and flow of the blood make correction of compliance impossible.

In the future, we may need to rely on the improvement of the actual dialysis machines, which would make the process much more efficient. Perhaps, this would require less flow through these grafts, which might decrease the severity of the occurrence of intimal hyperplasia. Many researchers are still investigating the pharmacologic alteration of intimal hyperplasia, but no one single agent is available that can correct the problem. Currently, we are involved in using laser photodynamic therapy at the venous site in a dog model of an arteriovenous prosthetic graft to determine if we can limit the amount of intimal hyperplasia that occurs and causes graft failure. This perhaps could be applied during the lifetime of the graft and could allow the grafts to function for longer periods of time with a bit of laser sculpting of the venous anastomotic end point.

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Submitted Apr 13, 2000; accepted Apr 14, 2000.

Please see the related articles by Dr Paul J. Gagne et al on pages 1149-54 and by Dr M. S. Lemson et al on pages 1155-63.